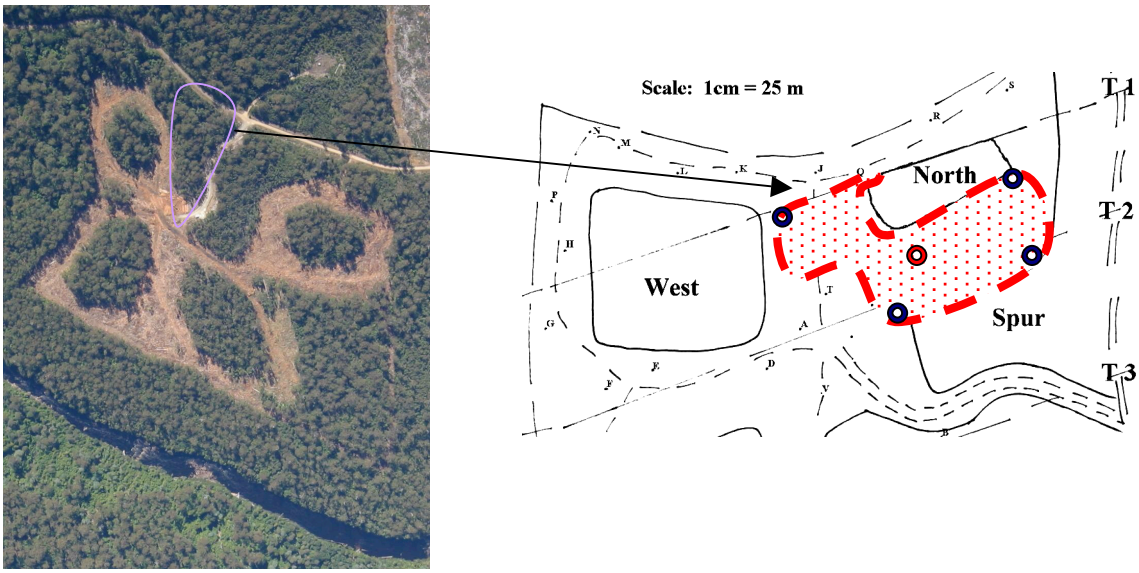
General details

The compartment selected for this study (Warra 8I) is located at the Warra long-term ecological research site managed by Forestry Tasmania. It is located near Port Huon, within 90 minutes travel from Hobart, and it covers 15 900 ha. It contains a tall *Eucalyptus obliqua* wet forest, with a full range of successional stages.
The 'corners' of the harvesting study area are represented in the diagram below:

South	4 73 602	52 28 167
East	4 73 652	52 28 230
North	4 73 627	52 28 277
West	4 73 482	52 28 200
Centre	4 73 595	52 28 217

Figure 1: Location of the trees harvested for this study within Warra 8I



At least two major fires were recorded in the area in the past, one in 1898 and the other in 1934. Most of the regrowth trees felled (with the exception of trees with DBHs below 25 cm) dated back to 1898. The trees with DBHs below 25 cm dated back to 1934. It is possible that some of the mature trees felled for this study dated back to 1750, judging by the age of one of the mature trees in the compartment that was not used in this study. However, the age of the mature trees used in this study was not determined. The main understorey species found in the forest were *Leptospermum scoparium, Melaleuca squarrosa, Phebalium squameum and Acacia verticillata.*

The selection o the trees and measurement of their DBHs was carried out on the week before the study. The study was carried out for five days in February, 2003. The study involved a harvesting crew, personnel from State Forests of NSW and Forestry Tasmania. The trees were felled using a chainsaw and removed from the forest with an excavator. In total 44 trees were felled specifically for the harvesting study. A Nikon … camera was used to photograph the study and a digital Sharp hand-held video camera was used to film the activities.

1.c) Weighing equipment

The weight measurements were carried out on weigh bars mounted on top of a trailer especially designed and built for harvesting and conversion studies. The weigh bars are made of galvanised steel (1200 mm long, Wedderburn Model WS-004 WBS) and are equipped with two load cells each (Class III load cells), with a combined capacity of weighing up to 5 tonnes. Weight increments of 0.2 kg up to 5 tonnes are displayed in a battery operated digital weighing indicator (Wedderburn Model DI 80).
The trailer was built by Libra Industries in Sydney (Figure 2). It is equipped with a heavy upper frame, each corner of which is supported by a two-speed drop leg. The legs are secured by four corner posts in either position, which in turn are secured by spring locking bolts. A levelling bubble is incorporated in the lower frame. The trailer is equipped with a Tandem axle and a full load sharing suspension rated to 3.5 tonnes. It is fitted with four wheel hydraulic brakes. The nominal dimensions of the trailer are:
Length load space: 2.5 m; length overall: 4.1m
Width load space: 1.8 m; width overall: 1.8m
Length drawbar: 1.6 m.

1.d) Field measurements

The diameter at breast height (DBH) of all trees felled in this study was measured with a diameter tape prior to felling. The tree height and the remaining stump height were measured with tape measures after the trees were harvested. The diameter of the butt and top of each log was also recorded. Most of the original full-length logs yielded at least two separate log products. All log products had their lengths and diameters measured after being graded according to their end use. “Crown” was defined here as the uppermost part of the tree after the commercial log was cut. Portions of the crown were also assessed and graded as pulp material. The length of the crown was obtained by subtracting the original sum of log product lengths from the original tree height.

1.e) Diameter (DBH) classes

The diameter classes of the trees selected for this study and the total number of trees harvested (in brackets) per diameter class were: for regrowth logs, 0-25 cm (4), 25-45 cm (5), 45-65 cm (15), above 65 cm (10) and mature logs (10). For mature logs there was no specification of diameter.

1.e) Sequence of activities

The same sequence of activities was followed for each tree harvested in this study:

a) Selection of trees: the trees were selected by personnel from State Forests of NSW and Forestry Tasmania to reflect as closely as possible the range and quality of trees that are harvested during a commercial harvesting operation in that area.
b) Measurement of tree DBH.
c) Felling of the tree using a chainsaw.
d) Measurement of the length of the tree and stump height.
e) Transport of the logs and crown from the forest to the log dump by an excavator.
f) Weight of the crown: the crown was lifted by the excavator and placed on a platform placed on top of the weight bars to allow measurement of material shorter than the span between the weigh bars.

g) Weight of full-length log (still with the bark on): the logs were placed on top of hardwood beams placed on the weigh bars to optimise load sharing. Some logs exceeded the capacity of the weigh bars; in those cases, they were either split or shortened and each component measured separately.
h) Debarking of the log (by the excavator).
i) Weight of the main log (debarked), as in "g".
j) Sampling of the log: disks were cut at both ends of the log for laboratory analyses, after the outermost sections were discarded. The disks were put in sealed plastic bags.
k) Grading and cutting of the log into log products. The log product categories used were: sawlog, veneer logs and pulp.
l) Measurement of length and diameters at both ends of each log product.
m) Weight of each log product as in "g".
n) Sampling of crown: random samples were cut with the chainsaw and placed in sealed plastic bags.

A visual assessment was undertaken to estimate any losses (crown material and bark) that may have occurred during to transport of each crown and log from the forest to the log dump.

1.f) Weight of bark and stump

1.f.1) Weight of bark
As the weight of each full-length log was determined with and without bark, the quantity of bark was determined by the difference between the two measurements.

1.f.2) Weight of stumps
The weight of each stump was determined by multiplying the calculated volume of each stump left in the forest by the green density of the "butt" section of the correspondent tree.

1.g) Weight recovery
The recovery of log products after the trees were harvested and the relevant biomass weighed was calculated as follows:
Weight recovery (%): Weight of log products (including pulp logs), tonnes /
(Weight of trees (crown + commercial stem + stump), tonnes *100

1.h) Laboratory analyses

1.h.2) Sapwood and heartwood content
The sapwood content of each tree used in this study was determined according to AS/NZS 1605:2000. The assessment was carried out on the disks (from butt and top ends) at four points across the diameter of the disk. An average sapwood content figure was obtained for each disk. The sapwood content of each tree was calculated as the average sapwood content of the butt and top disks. The average sapwood content of all messmate trees felled was then calculated. Some disks were broken during cutting or during transport. In those cases, the missing area was estimated based on the measurements of butt and top end diameter of each log product performed in the field.

1.h.3) Moisture content
Representative samples ("V"-shaped) were obtained from each disk and forest residues after their weights were recorded. The moisture content of the samples was expressed here both as percentage of the oven-dry mass of wood and of the fresh sample weight. The moisture

content of each tree was calculated as the average of four measurements (two samples per disk). Average moisture contents were then calculated for all messmate trees felled.

1.h.4) Density

Samples ("V"-shaped) used for the determination of moisture content were also used for the determination of density. The density of samples of forest residues (crown, branches and bark) was also determined. The volume of the samples was determined by the water displacement method (ASTM D2395-93). The density of the samples was expressed as "green density" (green weight / green volume), "basic density" (oven-dry weight / green volume) and "oven-dry density" (oven-dry weight / oven-dry volume). The density of each tree was calculated as the average of four measurements (two samples per disk). Average densities were then calculated for all messmate trees felled.

1.h.5) Carbon content

Sixty samples of messmate disks from 11 randomly selected trees as well as 10 samples of forest residues (two samples of foliage, six samples of branches and two samples of bark from two trees) were used for carbon content determination. The samples were initially air-dried and then oven-dried at 40°C before being milled to pass a 0.75 mm screen. Carbon content was determined by combustion decomposition followed by infra red detection using a LECO SC444 carbon analyser. The carbon determinations were carried out at the Chemical Centre in Western Australia. The carbon content of each sample was determined as the average of … replicates

1.i) Statistical analyses

All the statistical analyses were performed using a computer statistical package (Statistica 6).

1j) Total biomass

All the aboveground biomass present in the selected plot (300 m^2) was felled by chainsaw and removed from the forest to the log dump with an excavator. Four trees originally included in the harvesting recovery study were found in the plot (trees "8", "12", "13" and "23"). The understorey trees were grouped together and weighed in bundles on the trailer. It was estimated that approximately 5% of the biomass was lost during handling and transport of the trees.